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**BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES**

Application Number: 10/523,815
Filing Date: February 04, 2005
Appellant(s): KOHARA ET AL.

Gregory J. Maier
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed 7/1/09 appealing from the Office action mailed 3/3/09.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

The summary of claimed subject matter contained in the brief is correct.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

No evidence is relied upon by the examiner in the rejection of the claims under appeal.

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

3. Claims 21, 23 and 26-27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zywitzki (Surface and Coatings Technology 82 (1996) 169-175)

As to claim 21, Zywitzki discloses a method of producing α crystal structure-based alumina films comprising:

- An initial step of forming an undercoat of the alumina film having an a-crystal structure under conditions suited for formation of a-crystal structure

alumina by sputtering of an aluminum metal target in an oxidized gas-containing atmosphere (page 169, col 1: formation of alpha Al_2O_3 by PVD at substrate temperatures above 1000°C; page 170 col 1: sputtering using an aluminum target in reactive argon-oxygen atmosphere);

- Changing the film form forming conditions whereby an a-crystal structure alumina continues to be formed (page 173: graph of substrate temperature conditions for sputtering a-alumina).

It is noted that Zywitzki does not explicitly disclose the formation of the alumina structure in a two step process, but does disclose various temperature conditions in which a film may be formed and the resulting properties. No indication is given as to the order of these films or whether the films were indeed formed on the same substrate in a stacked manner. One of ordinary skill would recognize that the experiments were either performed on different substrates, each formed and tested separately or each layer was formed and tested subsequently on the same substrate, forming a stack of individual layers. The second scenario would read on the instant claim. Additionally, one of ordinary skill would recognize that in light of the disclosure of Zywitzki alumina films with high hardness can be formed at various temperatures (shown in figure 4) and therefore the temperature may be changed during the sputtering process for reasons of experimentation, energy savings, expected fluctuations from feedback controls or necessity to form a desired gradient coating.

As to claims 23 and 26, Zywitzki discloses a method of forming alpha alumina at different temperatures including 1000°C (page 169 col 1) 690°C and 760°C (page 174

col 2, summary and conclusions: alpha Al_2O_3 starts forming at 690°C and is solely formed at 760°C).

Although Zywitzki only specifically discloses the formation of alpha Al_2O_3 at these temperatures as separate data points with limited information on the specific experimental procedure involving the changing temperature, it would have been obvious to one of ordinary skill in the art at the time of the invention to start at a temperature of 1000°C and lower the temperature to 760 or 690°C because the lower temperature reduces the energy cost for the deposition, creates an alpha alumina with lower residual stress (fig. 5) and also maintains a relatively high hardness of the film within this temperature range (fig. 4).

As to claim 27, Zywitzki discloses conditions for subsequent film formation under which films with high hardness can be formed (page 169, col 1: formation of alpha Al_2O_3 [inherently of Mohs scale hardness 9]).

4. Claims 22, 25 and 28-29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zywitzki, as applied to claim 21 above, and further in view of Sproul (US 5,789,071).

As to claim 22, Zywitzki discloses the formation of a film under conditions to form α crystal structure alumina (as discussed above in claim 21), but is silent as to changing condition to a higher rate film formation for a subsequent film formation.

Sproul discloses a method of depositing alumina with the use of an aluminum target sputtered in an oxygen atmosphere (col 12 lines 37-44). Sproul also discloses

the increase of the deposition rate during the film formation (figure 15: showing changes of operating conditions during film deposition resulting in an increasing deposition rate).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to increase the deposition rate of alumina, as disclosed by Sproul, in the method of forming α-alumina of Zywitzki, because higher deposition rates reduce processing time.

As to claim 25, Zywitzki discloses the formation of a film under conditions to form α crystal structure alumina (as discussed above in claim 21), but is silent as to early stage film formation not exceeding 1 nm/min and subsequent film formation at a rate not lower than 3 nm/min.

Sproul discloses the changing of the film formation deposition rate from 1.5 to 3 A/sec, but is silent as to an early formation at less than 1 nm/min. It would have been obvious to one having ordinary skill in the art at the time of the invention was made to use a deposition rate less than 1nm/min since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. In re Antonie, 559 F.2d 618, 195 USPQ 6 (CCPA 1977). MPEP 2144.05 B.

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to use a low film formation rate following by a higher film formation rate as disclosed by Sproul, in the method of forming α-alumina of Zywitzki, because low deposition rates allow higher control over film formation conditions and higher deposition rates reduce processing time.

As to claim 28, Zywitzki discloses the formation of a film under conditions to form α crystal structure alumina (as discussed above in claim 21), but is silent as to changing the film formation conditions by application of a negative bias voltage increased in absolute value.

Sproul discloses the increasing of the absolute value of the bias voltage to the substrate and the deposition rate increasing as a result (figure 15: showing correlation of deposition rate increase as bias value to substrate is increased).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to increase the bias voltage, as disclosed by Sproul, in the method of forming α-alumina of Zywitzki because higher bias voltage results in higher deposition rates and reduced processing time (as shown in Sproul at Fig 15).

As to claim 29, Zywitzki discloses the formation of a film under conditions to form α crystal structure alumina (as discussed above in claim 21), but is silent as to early stage film formation with negative bias voltage not higher than 100 V and then negative bias voltage increased to 200 V or above in subsequent film formation.

Sproul discloses the increasing of the negative bias to the substrate in absolute value from -40 volts to -90 volts, but does not explicitly disclose exceeding 200 volts. It would have been obvious to one having ordinary skill in the art at the time of the invention was made to use a substrate bias exceeding 200 volts since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. In re Antonie, 559 F.2d 618, 195 USPQ 6 (CCPA 1977). MPEP 2144.05 B.

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to use a substrate bias under 100 volts followed by a higher substrate bias, as disclosed by Sproul, in the method of forming α-alumina of Zywitzki, because higher substrate bias correlates to a higher deposition rate, thus decreasing the time for a deposition operation (Sproul at fig 15: showing bias and rate correlation).

5. Claim 24 is rejected under 35 U.S.C. 103(a) as being unpatentable over Zywitzki, as applied to claim 21 above, and further in view of Fu (US 6,290,825).

As to claim 24, Zywitzki discloses the deposition of α crystal structure alumina, but is silent as to film formation carried out in a poisoning mode in an early stage of film formation and then a change to transition mode or metal mode in subsequent film formation.

Fu discloses a method of forming metallic layers within a reactive gas atmosphere including TiN or Al_2O_3 (col 1 lines 27-35). Fu also discloses a method of initiating the deposition at a poisoning mode and then moving into metallic mode (col 12 lines 1-5: ramp down 202 for poison mode, ramp up 200 for metallic mode; col 12 lines 13-17: initial deposition at poison mode followed by movement towards metallic mode). Sustained poisoning mode is disclosed as allowing the reactive gas to react with the target and reduce the sputtering rate while metallic mode raises deposition rates and keeps the target clean (col 11 lines 40-52).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to form a film in poisoning mode followed by film formation in metallic

mode, as disclosed by Fu, in the method of forming α crystal structure alumina of Zywitzki, because sustained sputtering in poisoning mode will significantly reduce the deposition rate as the target reacts with the processing gas.

(10) Response to Argument

Appellant argues on pages 4-7 of the Argument that Zywitzki does not disclose or suggest a two step process as required by instant claim 21 ("a subsequent second step of continuing to form the film on the undercoat by changing the film forming conditions." Instant claim 21).

Zywitzki discloses that alpha alumina film are normally only deposited at temperatures of above 1000 °C, but this temperature limits which substrates may be used during deposition (page 169, paragraph 3 and paragraph 5). Zywitzki offers further experimental results of alpha alumina film formation by magnetron sputtering at various temperatures under 1000 °C (pagraph 173: figure 4: showing deposition at various temperatures). As discussed by Zywitzki, it is known that alpha alumina can be formed at various temperatures effectively and it would therefore be within the purview of one of ordinary skill in the art to perform a sputter deposition process in which the conditions, such as the temperature, vary during the process because it is possible to form alpha alumina at a range of temperatures and reduced temperatures are beneficial when dealing with certain substrates.

Although Zywitzki does not explicitly disclose a two step process on a single substrate, as pointed out by Appellant, the experimental results disclosed by Zywitzki,

as discussed above, would make it obvious to one of ordinary skill that the temperature conditions of the sputtering process could be controlled as desired during the film deposition in order to obtain the desired film thickness and properties while protecting the substrate or other deposited layers from thermal damage.

Appellant argues on pages 7-8 of the Argument that Zywitzki in view of Sproul does not disclose or suggest the claim limitations of instant claim 22, specifically "changes in operating conditions during the film deposition resulting in an increasing deposition rate." Appellant argues that similarly to Zywitzki, Sproul only discloses various data points for deposition and does not explicitly disclose a two step process in which the deposition conditions are changed during the process.

Appellant alleges that figure 15 of Sproul, showing an increase in deposition rate in correlation to change in substrate bias and current density "merely shows data points for the deposition rates in separate experiments using separate substrates." No indication is to why Appellant believes these data points were obtained using different substrates. Col 13 lines 2-5 indicate how the data of figure 15 was obtained: "This was demonstrated by maintaining the radio frequency coil power at 100 watts. The increased substrate bias potential was then varied as indicated, indicating that the deposition rate increase with increased collection of the ionized aluminum." Although this explanation seemingly infers that the change in deposition rate occurred within a single multi-step process.

Regardless of whether Sproul explicitly discloses a multi-step process in which deposition rate is increased, as required by instant claim 22, one of ordinary skill in the art would recognize that during the deposition process of alumina, a change of deposition rate could be obtained by variation of substrate current density as illustrated by Sproul at figure 15. The deposition rate of the sputtering process could be controlled as desired during the film deposition in order to obtain the desired film thickness and properties.

Appellant argues on pages 8-10 of the Argument that Zywitzki in view of Fu does not disclose or suggest the limitations of claim 24.

Appellant first argues that Fu is not relevant to the instant claims because Fu is directed towards the sputter deposition of TiN and not alumina. Fu a sputtering process which can be applied to reactive sputtering: either oxides or nitrides of metals such as titanium and aluminum (col 1 lines 16-33: TiN formation or Alumina (Al_2O_3) formation). One of ordinary skill would recognize that although Fu gives specific examples using TiN, as pointed out by Appellant, the process of using pressure and reactive gas flow rates to regulate between metallic mode and poisoning mode of Fu would be applicable to not just Ti sputtering in a nitrogen atmosphere but also Al sputtering in an oxygen atmosphere. It would therefore be obvious to apply the teachings of Fu to other processes, especially the process of alumina formation disclosed by Fu as being similar in nature to TiN formation, as discussed above.

Appellant further argues that Fu does not disclose deposition in a poisoning mode followed by deposition in a metallic mode. Instant claim 24 contains the limitation of film formation first in a poisoning mode followed by a second step in a transition mode or metal mode. As Appellant points out, Fu discloses an example where metallic mode is followed by poisoning mode (col 12 lines 5-12). Fu also discloses an alternative scenario where metallic mode is not obtained first but rather a poisoning mode is obtained "immediately" (col 12 lines 16-17). An initial poisoning mode following by a pressure decrease (as shown by the arrow in figure 17) would cycle the process towards a transition mode and finally metal mode: the opposite scenario as starting with metal mode then transitioning to poisoning mode. This process would therefore suggest to one of ordinary skill in the art a process in which alumina formation may be performed by poisoning mode followed by a transitional and/or metallic mode.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

/J. M. B./

Examiner, Art Unit 1795

11/23/2009

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